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(54) Hall effect sensor system

(57) A sensor system for measuring linear displacement of a first member (10) relative to a second member (12), consist of an analogue Hall Effect sensor secured to the first member (10) in an orientation to sense magnetic flux in a sensing direction perpendicular to said direction of relative movement, and a permanent magnet (22) secured to the second member (12) and having a front surface facing the Hall Effect sensor and extending along the direction of relative movement between the first and second members (10, 12). The permanent magnet (22) is magnetised so that the front surface (24) has a first magnetic pole of a first magnetic polarity at a first end (28) and a second magnetic pole of a second magnetic polarity at a second end (30) spaced from the first end in the direction of travel.

Fig.1.

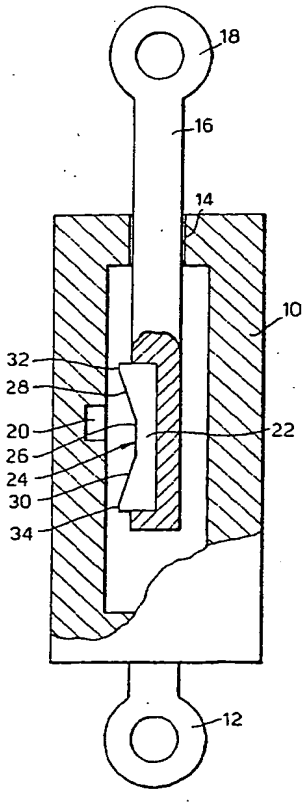

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Fig.1.

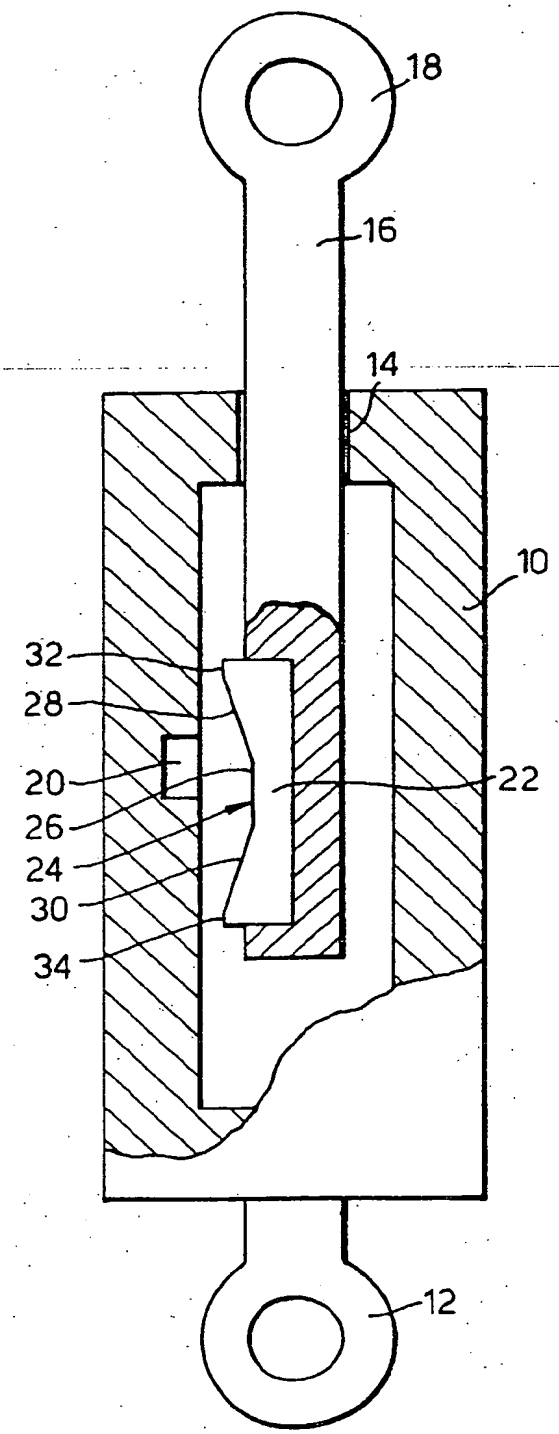
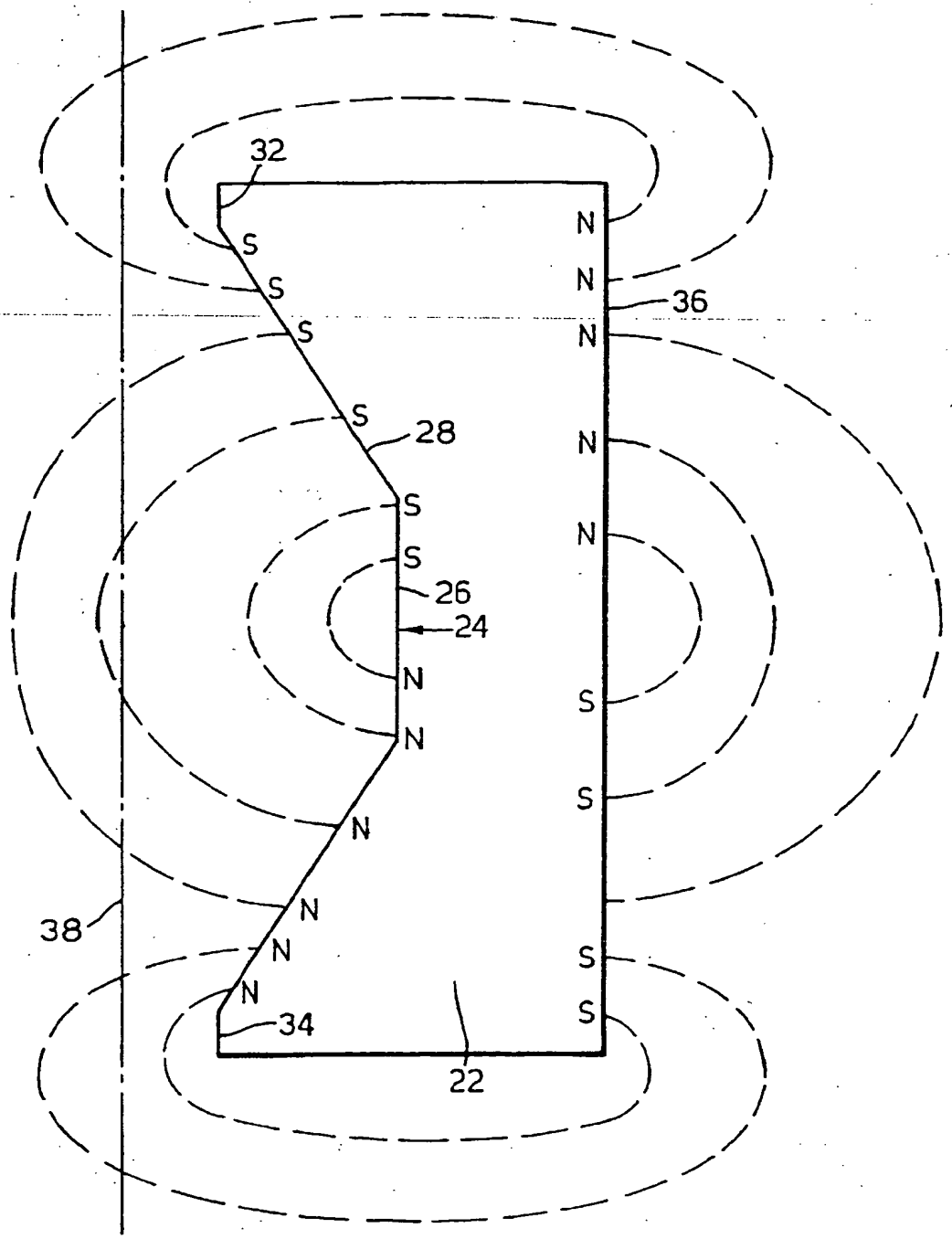


Fig.2.



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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 7998

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 493 216 A (ASA YUKIHIRO) 20 February 1996 * abstract; figures *	1-3	G01D5/14
Y		4-8	
D,Y	GB 1 109 220 A (CLARK EQUIPMENT) * the whole document *	4-8	
A	US 5 159 268 A (WU W T) 27 October 1992 * figure 7 *	4-8	
A	FR 1 339 956 A (GENERAL PRECISION) 15 January 1964 * column 2, line 1 - line 30; figures *	4-8	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 January 1999	Lloyd, P

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 30 7998

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20-01-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Description

[0001] This invention relates to a sensor system for measuring linear displacement of a first member relative to a second member, comprising an analogue Hall Effect sensor secured to the first member in an orientation to sense magnetic flux in a sensing direction perpendicular to said direction of relative movement, and a permanent magnet secured to the second member and having a front surface facing the Hall Effect sensor and extending along the direction of relative movement between the first and second members.

[0002] An analogue Hall Effect sensor produces an output voltage related to the component of the flux density of a magnetic field in which it is located which is perpendicular to its sensing surface. The sensor produces zero output voltage when subject to a magnetic field of sufficient strength in one direction and its maximum output voltage when subject to a magnetic field of the same magnitude in the opposite direction. In the absence of a magnetic field, the sensor produces an output voltage of half its maximum voltage.

[0003] GB-A-1109220 disclosed a sensor system of this type in which the front surface is concave in the direction of relative movement so that the magnetic flux at the Hall Effect sensor has a minimum value when the latter is positioned opposite a central location at which the concavity of the surface has maximum depth. A second Hall Effect sensor is mounted adjacent to the first sensor for simultaneous movement therewith. The outputs of the two sensors are combined electronically in order to determine the side of the central location on which the sensors are located.

[0004] According to the invention, in a sensor system of the type described above, the permanent magnet is magnetised so that the front surface has a first magnetic pole of a first magnetic polarity at a first end and a second magnetic pole of a second magnetic polarity at a second end spaced from the first end in the direction of travel.

[0005] With this arrangement, the Hall Effect sensor is exposed to a magnetic field which changes polarity as the first and second members pass through a relative position in the centre of their range. Consequently, the sensor can be arranged to produce its full range of output voltages, thus maximising the resolution obtained.

[0006] Preferably, the front surface is concave in the direction of relative movement between the first and second members and is shaped to cause the magnetic field to vary such that the normalised vector of the flux density passing through the Hall Effect sensor varies in a substantially linear manner along the path of the Hall Effect sensor. Consequently, the output voltage of the Hall Effect sensor bears a substantially linear relation to position.

[0007] An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a partially broken-away view of a linear position sensor system in accordance with the invention; and

Figure 2 is a flux diagram, on an enlarged scale, of a permanent magnet for the sensor system shown in Figure 1.

[0008] Figure 1 shows a linear position sensor system in accordance with the invention, comprising a hollow cylindrical housing 10 having a coupling eye 12 at one end, whereby it may be connected to one of the two members (not shown) whose relative position is to be measured. The housing 10 has a hole 14 at the end opposite to the coupling member 12. The hole 14 serves as a slide guide for a rod 16 which projects into the housing 10 and has a second coupling eye 18 on its outer end for connection of the two members whose relative position is to be sensed. In accordance with the invention, an analogue Hall Effect sensor 20 is embedded in the inner cylindrical wall of the housing 10 about half way along its length. The rod 16 carries an embedded permanent magnet 22 which is positioned with a front surface 24 confronting the Hall Effect sensor 20. The Hall Effect sensor 20 is preferably a so-called ratiometric Hall Effect sensor in which the output is linearly proportional both to the normal component of the flux vector passing through the sensing element and to the supply voltage.

[0009] The magnet 22 has a concavity in its front surface 24. The concavity has a flat central zone 26 extending parallel to the axis of the rod 16, on each end of which is a respective tapering intermediate zone 28, 30 and an end zone 32, 34 parallel to the central zone 26.

[0010] Figure 2 shows the magnet 22 on an enlarged scale with dotted lines representing lines of magnetic flux between respective magnetic poles designated N and S on its front surface 24 and corresponding poles of opposite polarity on its surface 36 opposite to the front surface. The path of the Hall Effect sensor is represented by a chain-dotted line 38. Satisfactory results have been achieved with a magnet of overall length 11.3 mm, width (perpendicular to the plane of Figure 2) 3 mm, and maximum thickness 3.8 mm; the central zone 26 being of length 3.5 mm and having a thickness 2.1 mm, and the end zones 32 and 34 each being of length 0.4 mm. Such a magnet is suitable for use in a sensing system where the distance between the end zones 32, 34 and the sensing element of the Hall Effect sensor 20 is 1.25 mm.

[0011] Sensor systems in accordance with the invention find particular application in rear view mirrors for motor vehicles of the type in which the orientation of the mirror house is adjustable relative to the mirror housing by means of two screw jack drives arranged to adjust the orientation of the mirror glass about mutually orthogonal axes. A mirror assembly of this type is described in EP-A-0549173. A respective sensor system in accordance with the invention may be associated with

each screw jack drive so as to provide an electrical signal indicating the actual position of the mirror glass. Such position sensor systems are required for use when such a mirror is used in conjunction with a system for storing a plurality of desired orientations for the mirror glass so that the mirror may be adjusted automatically in accordance with the requirements of a number of individual drivers.

Claims

1. A sensor system for measuring linear displacement of a first member (10) relative to a second member (12), comprising an analogue Hall Effect sensor secured to the first member (10) in an orientation to sense magnetic flux in a sensing direction perpendicular to said direction of relative movement, and a permanent magnet (22) secured to the second member (12) and having a front surface facing the Hall Effect sensor and extending along the direction of relative movement between the first and second members (10. 12), characterised in that the permanent magnet (22) is magnetised so that the front surface (24) has a first magnetic pole of a first magnetic polarity (N) at a first end (28) and a second magnetic pole of a second magnetic polarity (S) at a second end (30) spaced from the first end in the direction of travel.

2. A sensor system according to claim 1, wherein a surface (36) of the permanent magnet opposite to said front surface (24) has one magnetic pole of said second magnetic polarity (S) opposite to said first magnetic pole. and another magnetic pole of said first magnetic polarity (N) opposite to said second magnetic pole.

3. A sensor system according to claim 1 or 2, wherein the front surface (24) is of constant width in a direction perpendicular both to said direction of relative movement and to said sensing direction.

4. A sensor system according to claim 1, 2 or 3, wherein said front surface (24) is concave in the direction of relative movement between the first and second members (10, 12) and is shaped to cause the flux density to vary in a substantially linear manner along the path (38) of the Hall Effect sensor (20).

5. A sensor system according to claim 4, wherein the front surface (24) includes a central portion (26) comprising a plane surface perpendicular to the magnetic axis of said permanent magnet (22).

6. A sensor system according to claim 5, wherein the front surface includes two end portions (32, 34) comprising plane surfaces perpendicular to the magnetic axis.

7. A sensor system according to claims 5 or 6, wherein the front surface (24) includes two intermediate portions (28, 30) on opposite sides of the central portion (24), inclined at opposite angles to the magnetic axis.

8. A sensor system according to claim 7, wherein the intermediate portions (28, 30) comprise plane surfaces.